JUNIOR MASTER GARDENER® PROGRAMS IN RURAL GUATEMALA: A MODEL FOR INTERNATIONAL YOUTH DEVELOPMENT PROGRAMS

A Thesis

by

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ABSTRACT

This study examined the impact of selected Junior Master Gardeners (JMG) lessons on students' science knowledge gain, science attitudes, and life skill development. During summer 2013, sixth grade students (N = 84) and teachers (N = 11) from two rural schools in Guatemala participated in six weeks of JMG lessons. Students completed pre-and post- science knowledge tests, and pre-and post- science attitude and life skills surveys. Teachers completed surveys to evaluate their perceptions of JMG lessons and perceived impacts those lessons had on students' science learning and attitudes, and development of life skills.

Results showed that students' science knowledge significantly increased as a result of their participation in JMG lessons. No change in attitude toward science was observed in the student data; however, data from teachers' surveys indicated that teachers perceived JMG lessons were important in stimulating students' desires to learn science and in increasing students' interests in science. No significant change in students' perceptions of life skills development was observed; data from teachers' surveys indicated they perceived JMG lessons were important in helping students develop life skills such as communications and leadership. The lack of significant change in students' science attitudes and life skills development may be attributed to low internal reliability scores for both scales. Many previous studies conducted in the U.S. indicate that participation in 4-H, JMG, and other agricultural education activities facilitates changes in attitudes toward science and life skill development. Future studies

should address instrument reliability issues to improve research in this field or rely more heavily on teacher evaluation of JMG programs since research suggests that adults are better able to assess changes in attitudes and skills than youth.

Overall, this study suggests that there is great potential for the use of JMG programs in developing countries. Because of their impact on science education, science attitude, and life skills development, JMG programs should be accepted as viable tools for international development projects working toward a stronger, more educated, and more capable youth population in developing countries. Both science knowledge and life skills development are closely tied with economic prosperity and successful livelihoods so by giving youth these skills, JMG is preparing them for a better future. Before incorporating JMG into development projects, more time should be invested in adapting JMG lessons and activities to a rural Guatemalan context to maximize learning and ease of adoption.

DEDICATION

I would like to dedicate this thesis to my family and friends in Maryland. They were always there for me to give me strength, encouragement, and perspective when I needed it the most. I would also like to dedicate this specifically to my grandmother, Cathie Price, who first introduced me to 4-H and nurtured my passion for agriculture, leadership, youth development, community service, and education.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Wingenbach, for his intense dedication and energetic passion to helping his students succeed and grow academically. His guidance, constructive criticism, and excitement about learning gave me the extra push I needed to persevere through the both the research and writing process.

I would also like to thank my committee members, Dr. Warren and Dr. Ripley, and the resident JMG experts, Mr. Seagraves and Ms. Whittlesey, for their guidance and support throughout the course of this research.

Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience. I also want to extend my gratitude to the "A Broader View" staff, Petra Post and Juan Mario, and "Casa de los Tiempos" staff, Josan and Hans, who helped to coordinate my trip to Guatemala, add a culturally appropriate perspective to my research, and made me feel welcome while I was visiting their country.

LIST OF ACRONYMS

JMG: Junior Master Gardener

PYD: Positive Youth Development

STEM: Science, Technology, Engineering, and Mathematics

TEKS: Texas Essential Knowledge and Skills

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CHAPTER I

INTRODUCTION

Introduction

Global population is projected to increase by another 2 billion by 2050; scholars are searching for solutions that will effectively address the increasing demand for food. Today, 900 million people suffer from hunger with 98% living in developing countries (World Food Program [WFP], 2012). Of those 900 million hungry, 20% are children; every year hunger and hunger-related diseases result in the death of 5 million children under age five (WFP, 2012). Within Latin America and the Western Hemisphere, Guatemala has one of the highest rates of malnutrition with nearly 50% of children under the age of five being malnourished, making it the fourth highest in the world (WFP, 2012).

In addition to hunger, the persistence of low literacy rates worldwide also contributes to poverty. In developed countries such as the United States, literacy rates are nearly 100%; however, literacy rates in Latin America, especially in Guatemala, only average 69.1%, with decreasing rates in most rural communities (Central Intelligence Agency [CIA], 2012).

Unfortunately, rural youth are more likely to suffer from the negative consequences of poverty than urban youth (Sustainable Agriculture and Rural Development [SARD], 2007). Rural youth are generally not a target group for major policy decisions by governments in developing countries and are often times overlooked (Bennell, 2007). Rural youth in developing countries traditionally receive less education, have fewer opportunities for employment, are more likely to be involved in civil conflicts, and generally face more health problems than do urban youth (Bennell, 2007). Because of these struggles, rural youth tend to have lower productivity rates and are unable to become strong economic or social powers who can lobby on their own behalf (Bennell, 2007). However, many development agencies believe the fate of rural youth could easily be reversed if policies and programs focused on developing the potential of individuals in this group (SARD, 2007).

Global youth populations are rapidly increasing, thereby increasing youth's potential role in development (Global 4-H, 2012). In Guatemala, one-half of the country's population is under the age of 19 (CIA, 2012). For many, youth are considered "the strength of any nation" because they represent the next generation; programs focusing on educating youth, especially rural youth, ought to be encouraged and supported (Bennell, 2007; Major, 2011).

Recently, the FAO decided to make strengthening the rural youth community a priority in their developmental policies and programs (Bennell, 2007). For example, some of FAO's new goals include 1) providing children and youth with appropriate educational training that focuses on agriculture; 2) consulting with youth and taking into account their views and needs of programs before implementing policy; and 3) providing formal and informal training programs for youth in agriculture to facilitate the entry of youth into the workforce (SARD, 2007).

There are many youth development organizations in the U.S. that may serve as good models for creating international youth development programs. The National 4-H focuses on youth development and creating future leaders. With a foundation in agricultural science curriculum, youth development processes, and rural development capacities, 4-H is in a unique position to aid international agricultural development plans (Major, 2011).

National 4-H began in the late 1800's when researchers at public universities noticed that rural adults were unreceptive to accepting new agricultural technologies, but youth were far more open and willing to experiment with new ideas (National 4-H Council, 2012). Researchers found youth who were educated on new agricultural practices, actually shared their experiences, knowledge, and successes with their parents, which led to increased adoption rates among adults (National 4-H Council, 2012). Thus, the 4-H youth development program became an innovative way to diffuse new agricultural practices in farming communities (National 4-H Council, 2012). Since then, the organization has evolved, but the goal remains the same: "to build a world in which youth and adults learn, grow, and work together and act as a catalyst for positive change" (National 4-H Council, 2012).

Today, 4-H programs have expanded worldwide and by 2015, the Global 4-H Network hopes to double the number of youth outside the U.S. who are engaging in high quality positive youth development (PYD) opportunities and bring the total to nearly one million (Global 4-H, 2012). The goal of Global 4-H is to prepare youth to reach their full potential so they address urgent global needs such as hunger, poverty, sustainability, food security, and other global social justice issues (Global 4-H, 2012).

One example of the many 4-H programs extending beyond the United States to developing countries is the Junior Master Gardener® (JMG) Program. Through JMG, youth become involved in school garden projects, take part in other horticultural activities, and learn the basics about plant growth and care (Whittlesey, Seagraves, Welsh, & Hall, 2001). JMG programs use creative activities to present scientific concepts in soils and water, ecology, insects and diseases, the environment, landscape, fruits, vegetables, herbs, and nuts (Whittlesey et al., 2001). In addition to teaching children science, JMG programs also help children develop life skills and explore career opportunities (Whittlesey et al., 2001). By educating youth in agriculture and nutritional science, JMG may influence local economic development potential which could reduce hunger in developing countries. Junior Master Gardener programs have never been evaluated on an international setting, so their value in international agricultural development work remains unknown.

Literature Review

In most developing countries, Guatemala included, rural youth have limited opportunities to obtain a quality education and often the education they do receive is irrelevant and casts a negative light on rural agricultural lifestyles (Bennell, 2007; Major, 2011). Children are encouraged to pursue jobs in urban centers and leave their rural lifestyles and families, causing deficits in the agricultural workforce and brainpower needed to encourage and develop sustainable agricultural advances (Major, 2011; SARD, 2007). According to the FAO, there is an "urgent need to provide appropriate education, training, and job opportunities" for rural youth, enabling them to remain and prosper in rural areas and further the advancement of agriculture (SARD, 2007, p. 2). With creativity, energy, adaptability, capacity, and disposition to learn, young people are powerful agents of change and will be useful in forming solutions for sustainable development (SARD, 2007). Ashley and Maxwell (2001) found a strong correlation between investment in agricultural growth and poverty reduction. This finding suggests that programs such as 4-H and FFA, which promote continual learning and encourage self-sufficiency in agriculture, might be useful in maximizing rural development and reducing poverty (Major, 2011).

According to Knoblach, Ball, and Allen's (2007) study of teacher perceptions, incorporating agricultural education into the general curriculum of elementary and middle schools brings learning to life by providing experiential learning experiences for children. Experiential learning activities allow children to become more interested in what they are learning in the classrooms and pursue further opportunities to apply what they are learning in real-life situations (Knoblach et al., 2007). Agricultural education provides an authentic learning context for students and allows them to observe science in action with hands-on experiences making it easier for educators to teach more difficult and complex scientific issues (Knoblach et al., 2007). These hands-on experiences allow students to develop scientific inquiry skills and may produce more positive attitudes toward learning science (Klemmer et al., 2005b). Incorporating agricultural education into the curriculum may enrich a student's understanding in different content areas such as math, history, language arts, and the social sciences (Knoblach et al., 2007; Ozer, 2007).

Research found that elementary teachers valued agricultural education because it provided real world connections for their students, helping them appreciate the environment and value and respect farms, fields, and farmers (Boleman & Cummings, 2002; Knoblach, 2007) . Teachers indicated that agricultural education helped develop "a sense of connectedness to life" (p. 29) because it taught students about the life cycles of species such as insects, chickens, and livestock (Knoblach et al., 2007). Additional research on agricultural education programs also indicates these programs increase participants' interest in science, enhance participants' aspirations in science, contribute positively toward higher academic standards, and encourage students to become more enthusiastic about learning (Boleman & Cummings, 2002; Dewitt et al. 2011).

Agricultural sciences study may also help children develop life skills by improving their communications, leadership, and teamwork. According to Welsh and Bierman (as cited in Fleener, Robinson, & Williams, 2011), social skills are necessary for youth to develop strong social competence and integrate properly into society so it is essential that schools provide youth with opportunities to grow in society to develop into mature adults. Fleener et al. (2011) argued that school gardens and plant-based activities should be recognized as an avenue to achieving social skills. In addition to developing social skills, school garden programs have been shown to benefit emotional well-being and self-image, which may increase perceptions of self-esteem and decrease stress levels (Waliczek, Bradley, Lineberger, & Zajicek, 2000).

Research indicates that youth who participate in school agriculture programs confident in communication, better able to manage stress, more comfortable in working with groups, more likely to take on leadership roles, and more likely to get involved in community philanthropic activities as a result (Robinson & Zajicek, 2005). Therefore, one of the goals of 4-H programs is to develop youth into adults who are healthy, able to execute effective problem-solving skills, and contribute to their communities (Major, 2011). Youth involved in 4-H programs exhibited higher levels of development in the six C's that characterize "ideal adulthood": competence, confidence, connection, character, compassion, and contribution to self and community as a result of their participation (Lerner et al., 2005).

By strengthening children's interest in agriculture and science education and by fostering an environment to develop life skills, agricultural education programs can aid teachers in preparing youth to take action in solving emerging issues in their communities (Lerner at al., 2005).

Purpose of the Study

The purpose of this study was to assess the impacts of the Junior Master Gardeners (JMG) curriculum and lessons in Quetzaltenango, Guatemala. The objectives guiding this research were to determine:

1. Effect on students' understanding of scientific concepts, when analyzed by pre-and post-participation in selected JMG lessons;
2. Effect on students' attitudes toward science, when analyzed by pre-and post-participation in selected JMG lessons;
3. Teachers' perceptions of the selected JMG lessons and their effectiveness in teaching scientific concepts and influencing students attitude toward science;

4. Effect on students' perceptions of life skills development, when analyzed pre and post participation in JMG curriculum and lessons; and
5. Teachers' perceptions of students' life skill development as a result of participation in the JMG curriculum and lessons.

Methods

Approval to conduct this research was obtained from the Texas A&M University Institutional Review Board (#2012-0441) under the auspices of a larger research project conducted by Texas A&M researchers. It was determined that the referenced Institutional Review Board protocol number met the criteria for exemption and no further board review was required.

Research Design

A survey research design was used for this study. Survey research designs are often used to assess the outcomes or impacts or a given program or project on its participants (Fraenkel & Wallen, 2009). Survey research designs can also be used to evaluate the extent to which a program is meeting its goals and objectives (Fraenkel & Wallen, 2009). Two forms of survey research design were used in this study. A pretest-post-test program evaluation was used for student participants and a post-test only program evaluation was used for teacher participants.

The pre-post survey design involves assessing participants both before and after program activity. Program activity for this study was participation in six weeks of JMG lessons selected from *Junior Master Gardener teacher/leader guide: Level one*. For a complete list of JMG lessons conducted during this time, see Appendix C. Student participants responded to the same set of questions and statements in the pre-test as in the post test, allowing the researcher to measure change in knowledge, perceptions, or attitudes over time (Fraenkel & Wallen, 2009). The post-program survey evaluation involves assessing participants' attitudes only after they have completed the program activity. This design was chosen to asses teacher participants because it allowed them to evaluate the JMG program and the perceived impacts on students.

Population and Sample

The population included students and teachers from the schools in Zunil and Olintepeque, Guatemala. Only students and teachers who participated in JMG activities while the researcher was present were eligible to participate in this study. The researcher taught two classes of fourth grade, two classes of fifth grade, and two classes of sixth grade at each school. In total, the researcher worked with 12 classes, 12 teachers, and approximately 300 students. Only students in sixth grade classes participated in the research study because based on observations of the researcher, students in lower grades appeared incapable of comprehending and responding appropriately to survey questions. Students in sixth grade classes ranged from age 11 to age 17. However, teachers of lower grades were asked to participate in the teacher evaluation of the JMG curriculum and program.

Each sixth grade class consisted of 20 students and one teacher. Eighty-four sixth grade students completed the *Assessment of Students' Scientific Knowledge Gain;* 79 completed the *Survey of Students' Attitudes toward Science;* and 79 completed the *Survey of Students' Perceptions of Life Skill Development.* Ages of these students ranged from 10-14 years. Eleven teachers completed the *Teachers' Survey: Evaluation of the JMG Program* and the *Teachers' Survey: Evaluation of Life Skill Development.*

School attendance is very inconsistent among children in many developing countries, making a pre-defined sample unrealistic. School rosters are often unreliable, outdated, and difficult to obtain; choosing a sample before arrival to the village would be highly improbable (Levin & Lockhead, 2012). Inconsistent school attendance may affect intact groups' participation for JMG lessons during the summer 2013 program. Therefore, convenience sampling methods were used to obtain appropriate samples and accurate results. All students who were present on the days that the researcher administered instruments participated in this study.

Instrumentation

Five instruments were used to evaluate the five objectives of this study. Three of the instruments were used to assess students and two of the instruments were used to assess teachers. The instruments used to assess students consisted of one pre-then post assessment and two pre-then post surveys. The instruments used to assess teachers consisted of two surveys (See Appendix B for copies of the five instruments). Below is a list and brief description of the five surveys.

1) *Assessment of Students' Scientific Knowledge Gain*: a pre-then post assessment of students' understanding and knowledge of scientific and agricultural concepts.

2) *Survey of Students' Attitudes toward Science*: a pre-then post survey evaluating students' attitudes, aspirations, and self-concepts regarding science.

3) *Survey of Students' Perceptions of Life Skill Development*: a pre-then post survey evaluating students' self-perceptions of their individual life-skills.

4) *Teachers' Survey: Evaluation of the JMG Program*: a survey assessing teachers' opinions regarding the usefulness and impacts of the JMG curriculum and lessons in developing positive attitudes toward science amongst their students.

5) *Teachers' Survey: Evaluation of Student Life Skill Development:* a survey assessing teacher's opinions regarding the impact of the JMG curriculum and lessons on development of life skills amongst their students.

The *Assessment of Students' Scientific Knowledge* was a researcher developed instrument that had 25 multiple-choice and fill-in-the-blank questions about basic scientific and agricultural concepts. The instrument was developed based on examples and suggestions for developing science achievement evaluation instruments presented in Klemmer et al.'s (2005b) research study. Answer choices were presented in the form of pictures accompanied by words. Children have a limited and different use of vocabulary and understanding of words, so questions that rely solely on words may not be appropriate or reliable in evaluating a child's understanding of a certain concept (Punch, 2002). However, if children are allowed to work within a context adapted to their interests (i.e., picture surveys), they are capable of expressing their thoughts and opinions more accurately (Punch, 2002; Williams, 1970; Woodhead, 1998).

It is important to consider that child development models are not universal, they are socially and culturally unique, and researchers' expectations for U.S. children may not be reasonable for children in rural Guatemala (Woodhead, 1998). Youth literacy rates in Guatemala are much lower than those in the U.S. and the public education system is not nearly as developed (United Nations Children's Fund [UNICEF], 2011). While U.S. sixth grade students may be capable of accurately completing and understanding formal written surveys without pictures, the same generalization and expectations cannot be imposed on a population of sixth graders in rural Guatemala. Therefore, the researcher and a panel of educational experts decided that short pictorial-type questions would be more appropriate for children rather than written surveys without images. A sample question from this instrument was "From the images below, please circle the picture that does not represent part of a plant." The answers for this question were pictures of leaves, stems, roots, flowers, and worms with these words written below (See Appendix A).

Survey of Students' Attitudes toward Science consisted of nine Likert-scale type statements assessing students' perceptions toward science. This instrument was adapted from DeWitt et al. (2011) in a study of 10 and 11 year olds' aspirations and attitudes toward science. The original instrument measured 15 constructs using more than 62 individual statements; however, the researcher selected statements only from the constructs regarding "aspirations in science," "attitudes toward science," and "self-concept in science" (DeWitt et al., 2011). Many of the statements from the remaining 12 constructs of the original survey were outside of the context of this study. Only nine statements were selected to prevent the possibility of survey fatigue in research participants. All three of the selected constructs' scales were tested for reliability using

Cronbach's alpha and were found to have coefficients of 0.90, 0.86, and 0.84 respectively (DeWitt et al., 2011). Answer choices were presented on a five-point Likert-type scale and possible responses ranged from an extremely happy/smiling face to an extremely sad/frowning face with the corresponding written descriptions of "strongly disagree" to "strongly agree" respectively (See Appendix A).

Survey of Students' Perceptions of Life Skill Development consisted of 12 statements with a Likert-type scale response option evaluating participants' opinions of life skill development. This instrument was adapted from of the Youth Life Skills Inventory, YLSI (Robinson & Zajicek, 2005) used in a similar evaluation instrument of JMG programs for elementary school students.

The original YLSI instrument was tested for reliability and found to have a Cronbach's alpha coefficient with high internal consistency of 0.87 (Robinson & Zajicek, 2005). The YLSI instrument contained 32 statements and measured six constructs that defined life skills development: working with groups, understanding self, communication, making decisions, leadership, and volunteerism. However, some of these statements were deemed by the researcher as irrelevant to this study, based on the specific JMG lessons conducted in Guatemala. Also, because of time constraints, differences in cultural contexts, and a desire to prevent survey fatigue, the researcher chose only two statements from each of the six constructs to develop this survey instrument.

One-half of the statements were reverse-coded to increase the instrument's reliability and decrease acquiescence response bias (Watson, 1992). Answer choices were on a five-point Likert-type scale and possible responses ranged from an extremely happy/smiling face to an extremely sad/frowning face with the corresponding written descriptions of “strongly disagree” to “strongly agree” respectively (See Appendix A).

Evaluation of the JMG Program was a researcher developed instrument consisting of 18 Likert-type questions assessing teachers’ perceptions of the JMG curriculum and lessons in teaching scientific concepts and changing students’ attitudes toward science. A sample statement from this survey instrument was “I believe that JMG lessons were important in enhancing my students’ science learning abilities.” Answer choices were presented on a five-point Likert-type scale with possible responses ranging from “strongly disagree” to “strongly agree” (See Appendix B).

Evaluation of Life Skill Development consisted of 12 Likert-type scale questions assessing teachers’ perceptions of life skills development of their students as a result of participation in JMG activities. This instrument was also adapted from the YLSI instrument. Two statements were chosen from each of the six life skills constructs and reworded so they measured teachers’ rather than students’ perceptions of life skill development. The survey was shortened because of concerns about time constraints, survey fatigue, and differences in cultural contexts. Again, one-half of the statements were reverse coded to increase the instrument’s reliability (Watson, 1992). A sample statement from this instrument was “I believe that JMG lessons helped to improve my students’ abilities to work well in groups.” Answer choices were presented on a five-point Likert-type scale and possible responses ranged from an extremely “strongly disagree” to “strongly agree” (See Appendix B).

Data Collection Procedures

The research instruments used to assess student participants were distributed two days prior to students participating in JMG activities and again two days after all JMG activities had been completed. School teachers were responsible for collecting data, helping to minimize researcher bias in manipulating children to answer the question in a certain way (Punch, 2002). Student participants were given 45 minutes to complete the *Assessment of Students' Scientific Knowledge Gain, Survey of Students' Attitudes toward Science,* and *Survey of Students' Perceptions of Life Skill Development.*

The research instruments used to assess teacher perceptions of the JMG curriculum and lessons were distributed two days after all JMG activities had been completed. The researcher was responsible for distributing and collecting the surveys. Participants were given 45 minutes to complete the *Evaluation of the JMG Program* and *Evaluation of Student Life Skill Development.*

Data Analysis

Data were recorded in Excel and analyzed using descriptive statistics such as frequencies, medians, modes, ranges, percentiles, standard deviations, correlation tests, and tests of significance.

CHAPTER II

EFFECTS OF THE JUNIOR MASTER GARDENER'S (JMG) CURRICULUM ON SELECTED PARTICIPANTS' KNOWLEDGE AND PERCEPTIONS OF SCIENCE

Introduction

The public education system in Guatemala, along with its emphasis on STEM (Science, Technology, Engineering, and Mathematics), is currently underdeveloped and underfunded. Although there are countrywide policies and curriculum standards governing education, these laws are difficult to uphold and to follow because of the lack of or unequal distribution of resources to parents, teachers, and students (Avivara, 2012; United States Agency for International Development [USAID], 2013). Science curriculum and classes are especially prone to unequal resource distribution and allocation (Lewin, 2000). Science education is the most expensive area of curriculum because of the nature of the field, which generally requires more qualified teachers, access to costly equipment, curriculum, and technologies, and more hands-on teaching experiences (Lewin, 2000). It is estimated that less than 15% of all Guatemalan classrooms meet nationwide minimum standards and the average schooling for children is approximately four years (Avivara, 2012; USAID, 2013).

A nation's economic prosperity is closely tied to the level of STEM education and essential to developing effective citizens (Osborne, Simon, & Collins, 2003; STEM Education Coalition, 2012). Science skills are important in people's everyday lives because of increased mechanization and dependency on technology (Klemmer, Waliczek, & Zajicek, 2005b). Science literacy is important in the workplace because more jobs “demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problems” (National Research Council [NRC], 1996).

According to American Association for the Advancement of Science students in the U.S. often emerge from elementary school fearing mathematics and disdaining and generalizing science as a topic that is too dull to learn (Rutherford & Ahlgren, 1990). As opposed to viewing science as a fun, exciting, and evolving process of discovery, students tend to view science as an acquisition of a set of facts or rules, making it difficult for them to pursue opportunities for higher learning in the sciences (Klemmer et al., 2005b).

Junior Master Gardener (JMG) programs, a specialized 4-H curriculum operated out of the Department of Horticulture- Extension at Texas A&M University, provide children with the opportunity to experience science learning from a new perspective. JMG programs allow students to participate in school garden projects, take part in horticultural activities, and learn the basics about plant growth and care (Whittlesey, Seagraves, Welsh, & Hall, 2001). JMG programs use creative activities to teach students scientific concepts about soils and water, ecology, insects and diseases, the environment, landscape, fruits, vegetables, herbs, and nuts (Whittlesey et al., 2001).

Literature Review

Kellert (2002) argued that school garden programs such as Junior Master Gardeners (JMG) serve a potential platform for stimulating a child’s learning because nature is rapidly changing and attracting a child's attention, facilitating the child's capacity to learn and retain new ideas. Studies on the impacts of JMG, school garden programs, and other horticultural curriculum on young participants indicate that students involved in these programs are more likely to show higher scientific achievement, increased scientific literacy, a heightened passion for continued science learning, higher levels of cognitive thinking, and a more positive attitude toward school in general (Boleman & Cummings, 2002; Culin, 2002; Klemmer et al., 2005b; Pigg, Waliczek, & Zajicek, 2006; Wistoft, 2013). JMG programs provide students with activities to practice their problem solving and decision-making skills, which may help them to better analyze, synthesize, and solve problems within the science classroom (Klemmer et al., 2005b; Robinson & Zajicek, 2005). These problem solving skills are also transferrable to nearly any other school subject including mathematics, history, and social sciences (Ozer, 2007).

Research on JMG and similar youth agricultural education programs suggest this curriculum has many benefits that may be useful in developing countries (Klemmer et al., 2005a; Ozer, 2007; Robinson & Zajicek, 2005). Currently in Guatemala, there is no agricultural education curriculum in the public education system, although many youth often return to their agrarian lifestyles after completing school (Major, 2011). Introducing this curriculum into the public education system could benefit youth by preparing them for managing more efficient farming operations, providing them with added income and increased access to better nutrition and healthcare (Sustainable Agriculture and Rural Development [SARD], 2007). Also, by providing students with positive experiences with science, JMG lessons could further deepen students' level of enjoyment of science leading more students to pursue further education or career opportunities in science (Dewitt et al., 2011).

Purpose of Study

The purpose of this study was to measure effects of lessons in the Junior Master Gardeners' (JMG) curriculum on selected participants in Quetzaltenango, Guatemala. The objectives were to:

1. Evaluate the effect on students' understanding of scientific concepts, when analyzed by pre-and post-participation in selected JMG lessons;
2. Determine the effect on students' attitudes toward science, when analyzed by pre-and post-participation in selected JMG lessons; and,
3. Measure teachers' perceptions of the selected JMG lessons and their effectiveness in teaching scientific concepts and influencing students' perceptions of science.

Methods

A survey research design was used for this study's evaluation of the JMG program. Survey research designs are often used to assess the outcomes or impacts or a given program or project on its participants (Fraenkel & Wallen, 2009). Survey research designs can also be used to evaluate the extent to which a program is meeting its goals and objectives (Fraenkel & Wallen, 2009). Two forms of survey research design were used in this study. A pretest-post-test program evaluation was used for student participants and a post-test only program evaluation was used for teacher participants.

The pre-post survey design involves assessing participants both before and after program activity. Student participants responded to the same set of questions and statements in the pre-test as the post test, allowing the researcher to measure change in knowledge, perceptions, or attitudes over a period of time (Fraenkel & Wallen, 2009). The post-program survey evaluation involves assessing participants' attitudes only after they have completed the program activity. This design was chosen to asses teacher participants because it allowed them to evaluate the JMG program and the impacts they perceived it had on their students.

The population included sixth grade students (ages 11 to 17) and teachers from the schools in Zunil and Olintepeque, Guatemala. Only students and teachers who participated in JMG activities while the researcher was present were eligible to participate in this study. Convenience sampling methods were used to obtain appropriate samples and accurate results as opposed to a pre-defined sample which would have been difficult to obtain in a developing country because of unreliable school rosters and inconsistent school attendance. All students (N = 84) and teachers (N = 11) who were present when the researcher passed out surveys participated in this study.

The *Assessment of Students' Scientific Knowledge Gain* was a researcher developed instrument consisting of 25 multiple choice and fill-in-the-blank questions used to assess students' basic scientific and agricultural concepts. Answer choices were presented in the form of pictures accompanied by words. Children have a limited and different use of vocabulary and understanding of words, so questions relying solely on words may not be appropriate or reliable in evaluating a child's understanding of a certain concept (Punch, 2002). However, if children are allowed to work within a context adapted to their interests (i.e., picture surveys), they are capable of expressing their thoughts and opinions more accurately (Punch, 2002; Rohwer, 1970; Woodhead, 1998). Children in rural Guatemala have lower literacy rates than children in the U.S. so the researcher decided that short pictorial-type questions would be more appropriate for Guatemalan children rather than written surveys without images. A sample question from this instrument was "From the images below, please circle the picture that does not represent part of a plant." The answers for this question were pictures of leaves, stems, roots, flowers, and worms with these words written below each picture.

Survey of Students' Attitudes toward Science consisted of nine Likert-scale type statements assessing students' perceptions toward science. This instrument was adapted from DeWitt et al. (2011) in a study of 10 and 11 year olds' aspirations and attitudes toward science. The original instrument measured 15 constructs using more than 62 individual statements; however, the researcher selected statements only from the constructs regarding "aspirations in science," "attitudes toward science," and "self-concept in science" (DeWitt et al., 2011). All three of the selected constructs' scales were tested for reliability using Cronbach's alpha and found to have coefficients of 0.90, 0.86, and 0.84 respectively (DeWitt et al., 2011). Many of the statements from the remaining 12 constructs of the original survey were not selected because they fell outside of the context of this survey. Only nine statements in total were selected to prevent the possibility of survey fatigue in research participants. Half of the statements were reverse-coded to increase the instrument's reliability and decrease acquiescence response bias (Watson, 1992) Answer choices were presented on a five-point Likert-type scale and possible responses ranged from an extremely happy/smiling face to an extremely sad/frowning face with the corresponding written descriptions of “strongly disagree” to “strongly agree” respectively.

Evaluation of the JMG Program was a researcher developed instrument consisting of 18 Likert-type questions assessing teachers’ perceptions of selected JMG lessons in teaching scientific concepts and changing students’ attitudes toward science. A sample statement from this survey instrument was “I believe that JMG lessons were important in enhancing my students’ science learning abilities.” Again, half of the statements were reverse coded to increase the instrument’s reliability (Watson, 1992). Answer choices were presented on a five-point Likert-type scale with possible responses ranging from “strongly disagree” to “strongly agree.”

The research instruments used to assess student and teacher participants were distributed two days prior to students participating in JMG activities and again two days after all JMG activities had been completed. Students and teachers participated in six weeks of JMG lessons. See Appendix C for a complete list of JMG lessons conducted during this time. Student participants were given 35 minutes to complete the *Assessment of Students’ Scientific Knowledge Gain* and *Survey of Students’ Attitudes toward Science*. Teachers were given 25 minutes to complete the *Evaluation of the JMG Program*. Data were recorded in Excel data sheets and analyzed using descriptive statistics such as frequencies, medians, modes, ranges, percentiles, standard deviations, correlation tests, and tests of significance.

Results

Demographic Data

Student respondents (*N* = 84) included all who participated in six weeks of selected JMG lessons led by the researcher. Forty-six of the participants were male and 38 were female. Forty-three students participated in JMG lessons in Zunil and 41 students participated in Olintepeque.

Teacher respondents (*N* = 11) included all who were present in the classroom for the six weeks of selected JMG lessons led by the researcher. Four of the participants were male and seven were female. Five teachers from Zunil and six teachers from Olintepeque completed the survey.

Students' Scientific Knowledge Gain

Objective one was to evaluate the effect on students' understanding of scientific concepts as a result of participation in selected JMG lessons. Participants completed the *Assessment of Students' Scientific Knowledge Gain* pre-and post-participation in selected JMG lessons. Table 2.1 provides frequencies and percentages of correct responses for each of the 25 questions in the knowledge assessment for pre-and post-participation in the JMG lessons.

Students incorrectly answered eight of the 25 questions more often in the post-test than were observed in the pre-test; however no significant differences were detected. The researcher believes this phenomenon could be explained by lower levels of teacher involvement and assistance during the post-test versus the pre-test and/or by confusing diagrams in the water cycle portion of the assessment.

Table 2.1

Distribution of Responses to Science Knowledge Questions (N = 83)

	Pre		Post	
Questions[c]	*f* [a]	% [b]	*f* [a]	% [b]
Which one of the following do plants not need to survive? (Butterflies)	40	47.6	75	89.3
Which one of the following is not a part of a plant? (Worms)	51	60.7	40	47.6
Corn is an example of a: (Seed)	71	84.5	81	96.4
Broccoli is an example of a: (Flower)	29	34.7	53	63.1
Carrots are an example of a: (Root)	61	72.6	74	88.1
Which part of the plant is responsible for creating food? (Leaves)	14	16.7	17	20.2
Which part of the plant is responsible for providing strength and support against the wind and rain? (Stem)	37	44.0	41	48.8
Which image is not a part of soil? (Trash)	44	52.4	58	69.0
The blue particles are the biggest and represent: (Sand)	33	39.3	56	66.7
The red particles are the smallest and represent: (Clay)	26	31.0	41	48.8
This image is an example of: (Evaporation)	61	72.6	64	76.2
This image is an example of: (Transpiration)	37	44.0	32	38.1
This image is an example of: (Precipitation)	49	58.3	42	50.0
This image is an example of: (Evaporation)	58	69.0	52	61.9
How much of the earth's surface is covered in water? (3/4)	54	64.3	51	60.7
Order the images below in the correct order of the food chain. Number 1 represents the inferior part and number 6 represents the superior part of the food chain. (1= Dead leaves, 6 = Falcon)	65	77.4	62	73.8
It is healthy to eat more cookies than apples. (False)	49	58.3	77	91.7
It is healthy to eat more bread and tortillas than meat. (True)	78	92.9	49	58.3
I should eat fruits and vegetables every day. (True)	31	39.2	81	96.4
Which one of the following images represents mimicry? (Image of butterflies)	39	46.4	45	53.6
Which one of the following images represents camouflage? (Image of green insect)	42	50.0	44	52.4
Which one of the following images represents reverse camouflage? (Image of red insect)	26	31.0	37	44.0
Which of the following is not a benefit of insects? (Spread of diseases)	53	63.1	57	67.9
Which of the following is a benefit of insects? (Decomposition)	19	22.6	24	28.6
Insects use ____ to communicate? (Noses)	12	14.3	26	31.0

Note. [a] Frequencies represent number of students who correctly answered each question. [b] Represents percentage of students who correctly answered each question. [c] Answers to each question are given in parenthesis.

To determine overall knowledge gain of scientific concepts, the researcher summed individuals' scores for the science knowledge test. Reliability analysis was performed to determine the internal reliability of the science knowledge test. The reliability coefficient was 0.60, which George and Mallery (2003) considered a questionable score, but which they also deemed as satisfactory for use in social science research. This questionable internal reliability could be attributed to several factors such as low comprehension of pre-test questions, loss of question implication because of differences in culture and language, and/or participants' age (Dimitrov & Rumrill, 2003; Fallon & Schwab-Stone, 1994; Jacobs, 1991). Caution is warranted in generalizing the findings beyond the sample group.

The summed pre-and post-test scores were calculated; pre-test grand mean score was 13.56 (SD = 2.55), and the post-test grand mean score was 15.15 (SD = 2.63). A paired samples t-test was conducted on the summed pre-and post-test scores to determine if a significant difference was evident between pre-and post-test summed scores. Results indicated a significant difference (t = -7.52, $\alpha < 0.005$) between pre-and post-test science knowledge test scores. Participants in this study gained significant science knowledge as a result of their participation in the JMG lessons.

The researcher believed the significant differences in the summed science knowledge test scores could be attributed to other factors (such as gender or school location) beyond the JMG lessons. Therefore, the researcher conducted ANOVA tests with post-hoc analysis (Bonferroni) to determine if gender or school location affected the pre- or post-test summed scores. Table 2.2 provides the descriptive statistics for pre-and post-test summed scores when analyzed by school location. The JMG lessons were taught at two schools, Zunil and Olintepeque. Each school location had two sixth grade classes, which were designated as “A” and “B” to distinguish the groups.

Table 2.2

Impact of School Location on Pre-and Post-test Summed Scores(N = 82)

Dependent Variable	School Location	*n*	*M*	*SD*	*F*	*p*
Summed score of pre-test	ZunilA	23	14.04	2.84	1.06	0.37
	ZunilB	19	12.74	2.73		
	OlintepequeA	22	12.86	3.36		
	OlintepequeB	17	13.59	1.62		
	Total	81	13.32	2.77		
Summed score of post-test	ZunilA	23	14.96*	2.50	4.34	<0.01
	ZunilB	19	14.53*	2.27		
	OlintepequeA	21	16.00	2.70		
	OlintepequeB	19	17.00*	1.76		
	Total	82	15.60	2.49		

Note. *the mean difference is significant at the 0.05 level.

A significant difference (t = -7.522, df = 3, $\alpha < 0.005$) existed for post-test scores between school locations. OlintepequeB students achieved significantly higher science knowledge post-test scores (M = 17.00, SD = 1.76) than did students at ZunilA or ZunilB (M = 14.96, SD = 2.50; M = 14.53, SD = 2.27, respectively). This significant difference may be explained by variances in the school atmosphere and teacher attitudes between the two schools that were observed by the researcher. No significant differences were found when analyzed by gender, although other studies have indicated differences between boys’ and girls’ interest and ability to learn science (Baram-Tsabari & Kaadni, 2009; Klemmer et al., 2005b).

Students' Attitudes toward Science

Objective two was to determine the effect on students' attitudes toward science, when analyzed by pre-and post-participation in selected JMG lessons. Participants completed the *Survey of Students' Attitude toward Science* in pre-and post-participation in selected JMG lessons. Table 2.3 shows descriptive statistics for pre-and post-participation for attitudes toward science statements.

Table 2.3
Students' Attitudes of Science (N =79)

	Pre		Post	
Statements:	M^a	*SD*	M^a	*SD*
I would **not** like study more science in the future	2.43	1.38	2.23	1.35
I would like to work with science in the future	3.53	1.27	3.94	.93
I think I could be a good scientist one day	3.74	1.24	3.85	1.05
I am excited to go to science classes	3.74	1.14	3.87	.97
Science classes are **not** interesting	2.39	1.18	2.27	1.13
We do **not** learn interesting things in science classes	2.28	1.27	2.18	1.16
I do well in science classes	3.74	1.13	3.67	1.09
My friends think science classes are **boring**	2.44	1.18	2.55	1.21
I learn things quickly in science classes	3.91	1.45	3.97	1.15

Note. [a] Five-point Likert-type scale: 1 (Strongly Disagree) to 5 (Strongly Agree); 3 (No Opinion).

To determine the overall shift in participants' attitudes toward science, the researcher summed individuals' scores for the science attitude scale. Prior to creating a summed score a reliability analysis was performed. Cronbach's alpha coefficient for the pre-test was 0.57 and the reliability coefficient for the post-test was 0.47, indicating an unacceptable reliability (George & Mallery, 2003). This low reliability was again attributed to a variety of potential factors, such loss of intended implication of questions as a result of translation, short time period intervention, cultural differences underlying child's conceptualization and understanding of "science," and the participants' young age (Dimitrov & Rumrill, 2003; Fallon & Schwab-Stone, 1994; Jacobs, 1991). The findings should not be generalized beyond the sample group.

The summed pre-and post-test scores for each individual were calculated and a paired samples *t*-test was conducted. No significant difference was found between pre-test (M = 31.83, SD = 6.73) and post-test scores (M = 32.64. SD = 5.97) for the science attitudes scale. Students agreed (M = 3.51 to 4.50) in both the pre-and post-tests that they would like to work in science or be a scientist in the future, science classes are exciting, and they do well and learn quickly in science classes. Students disagreed (M = 1.5 to 2.50) in both the pre-and post-tests that they would not like to study science in the future, science classes are not interesting, we do not learn interesting things in science classes, and peers think science classes are boring.

Teachers' Perceptions of Selected JMG Lessons

Objective three was to measure teachers' perceptions of the selected JMG lessons and their effectiveness in teaching scientific concepts and influencing students' perceptions of science. Teacher participants completed the *Evaluation of the JMG curriculum* post-participation in selected JMG lessons. Table 2.4 provides means and standard deviations for teachers' responses to each of the 18 statements.

Table 2.4

Teachers' Perceptions of JMG's Effectiveness and Influence on Students (N = 11)

I believe Junior Master Gardener (JMG) lessons …	*M*[a]	*SD*
Were important in enhancing my students' current studies	4.18	.41
Were **not** important in enhancing my students' science learning abilities	1.73	.47
Were **not** applicable or relevant for students in developing countries	1.80	.63
Were important in stimulating my students' desire to learn more about science	4.55	.52
Contained important information and activities for students in developing countries	4.27	.47
Are an educational tool I would like to incorporate in the future	4.55	.52
Are an educational tool I feel comfortable using	4.09	.54
Were **not** effective in teaching my students about plant needs	1.64	.51
Were effective in teaching my students about plant parts	4.45	.52
Were **not** effective in teaching my students about different soil types	1.73	.47
Were effective in teaching my students about soil composition	4.36	.51
Were effective in teaching my students about the water cycle	4.36	.51
Were **not** effective in teaching my students about soil erosion	1.64	.51
Were effective in teaching my students about the food chain	4.55	.52
Were **not** effective in teaching my students about the food web	1.45	.52
Were **not** effective in teaching my students about insect survival mechanisms	1.91	.83
Were effective in teaching my students about the benefits of insects	4.36	.51
Were effective in teaching my students about nutritional needs	1.73	.47

Note. [a] Five-point Likert-type scale: 1 (Strongly Disagree) to 5 (Strongly Agree); 3 (No Opinion).

Reliability analysis showed a Cronbach's alpha coefficient of 0.92, indicating a high internal reliability (Peterson, 1994). Tests of significance were not conducted for this data because of the low sample size (N = 11) (Fraenkel & Wallen, 2009). Caution is warranted in generalizing the findings beyond the sample group. However, observations of the overall means for each question are useful in determining teachers' perceptions of the selected JMG lessons. Teachers disagreed (M = 1.5 to 2.50) with all eight of the negatively phrased statements, agreed (*M* = 3.51 to 4.50) with seven, and strongly agreed (*M* > 4.51) with three of the positively phrased statements regarding the selected JMG lessons.

Conclusions and Recommendations

This study revealed a significant difference between students' pre-and post-test scores for the science knowledge test as a result of participating in six weeks of JMG lessons. No change in attitude toward science was observed in the student data; however, data from teachers' surveys indicated that teachers perceived JMG lessons were important in stimulating students' desires to learn science and in increasing students' interests in science.

Students Scientific Knowledge Gain

The post-hoc ANOVA revealed that this difference may be explained by differences in school atmosphere and teacher attitude. Zunil sixth grade teachers left the classroom during the researcher's JMG instruction time as opposed to teachers at Olintepeque who stayed in the classroom to help manage, discipline, and motivate students during the JMG activities. Based on the researcher's observations, Zunil teachers did not appear as attentive to students' needs or as interested in participating in JMG lessons as did Olintepeque teachers. Classroom management was more difficult and student attentiveness was lower at Zunil. The results of the post-hoc analysis appear to reflect the differences of teachers' attitudes on students' abilities, willingness to learn, and understand scientific concepts. These findings are supported by research indicating that teacher attitude, participation, and discipline impact students' abilities to learn (Allen, Witt, & Wheeless, 2006).

Practical implications for JMG teachers in the future would be to encourage all teachers to participate in, help with, and stay for JMG lessons to promote student learning and interest in JMG activities in the future. Such encouragement will equalize student learning environments and minimize the impact that external effects have on student learning. Future studies might also consider evaluating the impact that a teacher's participation or teaching style has on student learning.

Because JMG increases students' scientific knowledge gain using fun and creative activities, it should be considered as a strategic tool by international development programs aiming to improve education and/or science education in developing countries. Research shows that STEM education is closely related to a country's development so by giving students skills they need to understand the world around them and solve problems at a young age will be useful for creating a strong foundation for a country's future (Osborne, Simon, & Collins, 2003).

Students' Attitudes toward Science

No significant difference was found between pre-and post-summed scores for science attitudes, indicating no increase or decrease in positive perceptions toward science, science abilities, or science aspirations as a result of participation in selected JMG lessons. Students' attitudes about science were positive both pre-and post-participation in selected JMG activities.

Results indicated a questionable (0.60) and low, unacceptable reliability coefficients (0.57 and 0.41) for both the science knowledge assessment and science attitude scale. These reliability coefficients may be explained by a variety of factors such as low comprehension of pre-test questions, loss of intended implications as a result of differences in culture and language, participants' young age, influence of teacher assistance, and confusing diagrams (Dimitrov & Rumrill, 2003; Fallon & Schwab-Stone, 1994; Jacobs, 1991). Students taking the pre-assessment may have been unfamiliar with some of the scientific vocabulary or concepts presented in the questions, making them unsure of how to interpret and answer questions. This unfamiliarity can cause pre-test difficulty levels to be higher than that of the post-test, leading participants to guess on answers rather than apply their actual knowledge (Jacobs, 1991). The raw scores obtained from this test may not represent actual ability of the participants underlying their performance on the test (Dimitrov & Rumrill, 2003). It is expected that post-assessment questions will have a higher reliability because after six weeks of JMG lessons, students should better understand the scientific vocabulary and concepts, helping them to better interpret questions.

Variances in the interpretation of questions caused by differences in language and culture between the participants and the researcher may have decreased the reliability of the test (Bowling, 2005). The Spanish version of the test may not be linguistically equivalent to the English version, causing some statements to be unidiomatic, leading to a loss of intended implication of questions as a result of translation (Berkanovic, 1980).

Cultural differences underlying child's conceptualization and understanding of "science" may have also contributed to the low reliability. The way U.S. students perceive science may be entirely different than the way rural Guatemalan students perceive science due to difference in culture, geographical areas, and societal norms. It is also important to consider that learning and assessment strategies between cultures will vary so these materials should be adapted in such a way that maintains and incorporates students' cultural and linguistic identities (Lee, 2001). Future studies should ask: "What counts as "science"? What and how should science be taught? And how can students' learning be assessed in valid and fair ways?" (Lee, 2001).

The young age of participants may have contributed to low reliability because of children's inability to interpret questions and concentrate for long periods (Fallon & Schwab-Stone, 1994). Research also demonstrates that reliability of instruments evaluating children's' emotions, such as perceptions about science, are less reliable than those evaluating observable concrete behaviors and ideas (Fallon & Schwab-Stone, 1994).

Reliability of the science knowledge scale may have been impacted by teachers' level of influence and assistance during the test-taking and confusing diagrams on the test. While attempting to help students answer questions, some teachers may have actually been giving students correct or incorrect answers, leading to more randomized responses. Teachers' level of influence on classroom management and discipline may have impacted reliability because some teachers helped to create a controlled testing environment and minimize student cheating and disruptions, while others did not. Also, some of the diagrams used in selected JMG lessons were slightly different than those used on the science knowledge assessment which may have confused some students and caused them to select a wrong answer in the post-test.

For future studies, the researcher recommends that an expert or group of experts in educational psychology review the instrument for internal validity to ensure children feel comfortable with and understand the phrasing, structure, and complexity of questions. Also, native Guatemalan teachers should review the Spanish version of the test after initial translation to ensure linguistic equivalence and increase reliability. During the test and retest, instructions for how teachers should help students should be more thoroughly explained to decrease teacher influence on students' responses, encourage student cooperation, and enforce students to complete the tests individually. Increased reliability in future studies may allow the researcher to better measure and detect differences between pre-and post-test scores on the science knowledge scale and science attitudes scale.

Teachers' Perceptions of Selected JMG Lessons

Results for the teacher's *Evaluation of the JMG Program* indicated that teachers had an overall positive perception toward the selected JMG lessons. Teachers felt selected JMG lessons were important in enhancing students' science learning abilities, stimulating students' desire to learn science, enhancing science curriculum, and were effective in teaching a variety of scientific concepts. Teachers also indicated that they would feel comfortable incorporating and would like to incorporate JMG lessons into future science curriculum because the JMG lessons were relevant and important for students studying science in developing countries.

The reliability for the teacher scale was high. Reliability of adult surveys is predictably higher than that of children surveys because of higher levels of cognition (Fallon & Schwab-Stone, 1994). Although the survey evaluating student attitudes toward science had a low reliability, the teacher survey provides an alternate more reliable method for analyzing impacts on student attitudes toward science. Student surveys indicated no change in attitude toward science; however, teacher surveys indicated that JMG lessons enhanced (M = 4.18, SD = 0.41) and stimulated (M = 4.55, SD = 0.52) students' desire to learn science. Future research should consider collecting more data from teachers to increase the study's reliability and significance in a broader context.

Even though students' data indicated no change in science attitude, teacher data revealed that JMG lessons contribute significantly to a child's understanding and interest in science. Future studies should test the impacts of the JMG program on a larger group of teachers for an extended period of time to see if results are consistent. The researcher also recommends asking the teachers for their input evaluating the usefulness and practicality of various JMG lessons. While conducting this study, the researcher noticed that some lessons in the *Junior Master Gardener teacher/leader guide: Level one* were culturally inappropriate or difficult to execute due to lack of resources and time. For example, JMG lessons about landscaping, certain crops and animals unique to the U.S., and ideas, concepts, and people significant to American history may not make sense to a rural Guatemalan child. Also, some lessons required certain materials such as candy or tools that are only accessible in the U.S. and hard to find or expensive in Guatemala.

To make JMG curriculum more effective and applicable for teachers in rural Guatemala, practitioners should survey local teachers and conduct and evaluation to determine which lessons are acceptable, which lessons can be easily modified and how, and which lessons should be completely discarded in this cultural context. The results from this future study will make it easier for teachers interested in JMG to more easily incorporate it into their curriculums.

CHAPTER III

STUDENTS' AND TEACHERS' PERCEPTIONS ABOUT DEVELOPMENT OF LIFE SKILLS AS A RESULT OF THE JMG LESSONS

Introduction

National 4-H is one of the nation's leading youth organizations and serves as an avenue for children and youth to participate in hands-on learning experiences in the fields of agricultural sciences, art, mechanics, leadership, and citizenship (National 4-H Council, 2012). Through 4-H activities, participants engage in a variety of positive youth development (PYD) experiences. According to the U.S. government's Interagency Working Group on Youth Programs (IWGYP) (2013), PYD experiences are "intentional, pro-social approach that engages youth within their communities, schools, organizations, peer groups, and families" (p. 1) and encourages them to participate in activities that foster and encourage learning and service, formation of positive relationships, and development of life skills.

Life skills are abilities that "enable individuals to deal effectively with the demands and challenges of everyday life," such as leadership and communication skills (World Health Organization [WHO], 2003, p. 2). Life skills help youth develop self-confidence, and empower youth to take positive action in protecting and promoting their well-being, and help youth transition into adulthood (Norman & Jordan, 2008).

Research on 4-H programs indicates that youth who participate in 4-H activities have increased life skill development (Maass, Wilken, Jordan, Culen, & Place, 2006;

Ferrari, Houge, & Scheer, 2004; Fox, Shroeder, & Lodl, 2003). A retrospective study of 4-H alumni found that many considered 4-H to have been a primary influence on the development of several of their life skills such as responsibility, presentation skills, leadership, and self-confidence (Fox et al., 2003). Other life skills that 4-H alumni associate with involvement in 4-H include improved public speaking, community service and volunteering, self-discipline, teamwork, self-esteem, social skills, and responsible citizenship (Maass et al., 2006).

Parents' perceptions of a 4-H clover bud program in Ohio indicate that 4-H's impact on life skill development is present even among participants of a young age, ages five to eight (Ferrari et al., 2004). Parents agreed that 4-H played a key role in developing skills that their children need to be successful in the future (Ferrari et al., 2004). Childhood and early adolescence are times of rapid change; involving youth in 4-H activities during these times may positively influence their life skill development and emotional well-being (Fox et al., 2003; Waliczek, Bradley, Lineberger, & Zajicek, 2000).

PYD programs for rural youth, such as 4-H, could be beneficial in developing countries where rural youth are generally overlooked, forgotten, and not given adequate opportunities to develop into responsible adults (Bennell, 2007). Rural youth in developing countries traditionally receive less education, have fewer opportunities for employment, are more likely to be involved in civil conflicts, and generally face more health problems than urban youth (Bennell, 2007; United Nations Educational Scientific and Cultural Organization [UNESCO], 2012). Because of these struggles, rural youth tend to have lower productivity rates and are less likely to become strong economic or social powers that are able to lobby on their own behalf (Bennell, 2007).

One example of a PYD program that could be used to empower youth in developing counties is Junior Master Gardeners, or JMG. JMG is a specialized 4-H program that gives youth the opportunity to be involved in school garden projects, take part in other horticultural activities, and learn the basics about plant growth and care (Whittlesey, Seagraves, Welsh, & Hall, 2001). JMG curriculum and lessons can be incorporated into existing natural science curriculum or can be used through the addition of an after school JMG program. Through interactive science lessons and activities, group work, and lesson plans that directly target life skill development, JMG programs aim to prepare youth for successful livelihoods, enabling them to become active contributors within their communities (Whittlesey et al., 2001).

Many life skills are also classified as livelihood skills. Livelihood skills refer to those skills that enable youth to pursue individual and household economic goals in the future (WHO, 2003). Development of life skills prepares youth for successful livelihoods by preparing them with the skills necessary to seek jobs, continue their education, manage a businesses, manage their finances, organize their daily tasks, and even make responsible decisions about health and nutrition (WHO, 2003). According to Welsh and Bierman (2008), life skills are necessary for youth to develop strong social competence and integrate properly into society so it is essential that schools provide youth with opportunities to grow and to develop into mature adults (as cited in Fleener et al., 2011). Agricultural education programs, such as 4-H and JMG, have the potential to improve living standards and aid in poverty reduction by providing youth with the skills necessary to become successful adults who positively contribute to their communities (UNESCO, 2012; WHO, 1999).

Purpose of Study

The purpose of this study was to assess the impacts of the Junior Master Gardeners (JMG) curriculum and lessons in Quetzaltenango, Guatemala. The objectives guiding this research were to determine:

1. Effect on students' perceptions of life skills development, when analyzed pre and post participation in select JMG lessons; and
2. Teachers' perceptions of students' life skill development as a result of participation in select JMG lessons.

Methods

A survey research design was used for this study. Survey research designs are often used to assess the outcomes or impacts or a given program or project on its' participants (Fraenkel & Wallen, 2009). Survey research designs can also be used to evaluate the extent to which a program is meeting its goals and objectives (Fraenkel & Wallen, 2009). Two forms of survey research design were used in this study. A pre-post program evaluation was used to assess student participants and a post-program evaluation was used to assess teacher participants. Students and teachers participated in six weeks of JMG lessons. See Appendix C for a complete list of JMG lessons conducted during this time

The pre-post survey design involves assessing participants both before and after program activity. Student participants responded to the same set of questions and statements in the pre-test as the post test, allowing the researcher to measure change in knowledge, perceptions, or attitudes over a period of time (Fraenkel & Wallen, 2009). The post-program survey evaluation involves assessing participants' attitudes only after they have completed the program activity. This design was chosen to asses teacher participants because it allowed them to evaluate the JMG program and the impacts they perceived it had on their students.

The population included sixth grade students (ages 11 to 17) and teachers from the schools in Zunil and Olintepeque, Guatemala. Only students and teachers who participated in JMG activities while the researcher was present were eligible to participate in this study. Convenience sampling methods were used to obtain appropriate samples and accurate results as opposed to a pre-defined sample which would have been difficult to obtain in a developing country because of unreliable school rosters and inconsistent school attendance. All students (N = 84) and teachers (N = 11) who were present when the researcher passed out surveys participated in this study.

Students' Perceptions of Life Skill Development consisted of 12 statements with a Likert-type scale response option evaluating participants' opinions of life skill development. This instrument was adapted from of the Youth Life Skills Inventory, YLSI, (Robinson & Zajicek, 2005) used in a similar evaluation instrument of JMG programs for elementary school students.

The original YLSI instrument was tested for reliability and found to have a Cronbach's alpha coefficient with high internal consistency of 0.87 (Robinson & Zajicek, 2005). The YLSI instrument contained 32 statements and measured six constructs that defined life skills development: working with groups, understanding self, communication, making decisions, leadership, and volunteerism. However, some of these statements were deemed by the researcher as irrelevant to this study, based on the specific JMG lessons that were conducted during the study. Also, because of time constraints, differences in cultural contexts, and a desire to prevent survey fatigue, the researcher chose only two statements from each of the six constructs to develop this survey.

Half of the statements were reverse-coded to increase the instrument's reliability and decrease acquiescence response bias (Watson, 1992). Answer choices were on a five-point Likert-type scale and possible responses ranged from an extremely happy/smiling face to an extremely sad/frowning face with the corresponding written descriptions of "strongly disagree" to "strongly agree" respectively.

Evaluation of Life Skill Development consisted of 12 Likert-type scale questions assessing teachers' perceptions of life skills development of their students as a result of participation in JMG activities. This instrument was also adapted from the YLSI instrument. Two statements were chosen from each of the six life skills constructs and reworded so that they were directed at teachers' rather than students' perceptions of life skill development. The survey was shortened because of researcher concerns about time constraints, survey fatigue, and differences in cultural contexts. Again, half of the statements were reverse coded to increase the instrument's reliability (Watson, 1992). A sample statement from this instrument was "I believe that JMG lessons helped to improve my students' abilities to work well in groups." Answer choices were presented on a five-point Likert-type scale and possible responses ranged from an extremely "strongly disagree" to "strongly agree."

Participants had 20 minutes to complete their surveys. Student surveys were completed two days pre-participation in JMG lessons and two days post-participation.. Teacher surveys were completed two days post-participation in JMG lessons. Data were recorded in Excel data sheets and analyzed using descriptive statistics such as frequencies, medians, modes, ranges, percentiles, standard deviations, correlation tests, and tests of significance.

Results

Demographics

Student respondents (N = 84) included all students who were present during the six weeks of selected JMG lessons led by the researcher in Quetzaltenango, Guatemala. Forty-six of the participants were male and 38 of the participants were female. Forty-three students participated in JMG lessons in Zunil and 41 students total participated in JMG lessons in Olintepeque.

Student Perception of Life Skill Development

Respondents completed the *Survey of Students' Life Skill Development* pre-and post-participation in select JMG lessons. Data were then used to answer research objective 4 and evaluate the effect on students' perceptions of life skills development as a result of participation in JMG. Table 3.1 shows means and standard deviations for the pre-and post-survey.

Table 3.1

Students' Perceptions of Life Skill Development (N=80)

	Pre		Post	
Statements	*M*	*SD*	*M*	*SD*
I do **not** work well with others	2.12	1.08	1.91	1.02
I am proud of myself when I accomplish something	3.96	1.23	4.13	.93
It is important to listen to what other people have to say	3.83	1.15	3.95	1.04
I do **not** think that it is important that all group members help to do work	2.46	1.32	2.63	1.25
Before deciding anything, I think that it is important to think about all of my options	3.72	.95	3.91	1.00
I feel comfortable teaching other people new things	4.09	1.10	4.07	1.26
I think that if I do something wrong, it is ok to **blame** someone else	2.06	1.24	2.08	1.23
I like to do things to help improve the lives of others	4.21	1.02	4.11	.97
I do **not** follow instructions well	2.03	1.16	2.07	1.06
When making a decision it is not important to think about good and bad things that could happen	2.51	1.42	2.73	1.19
I think that it is important to help other people	4.37	.79	4.03	1.13
I do **not** like to be the leader of a group	2.45	1.30	2.80	1.38

Note. [a] Five-point Likert-type scale: 1 (Strongly Disagree) to 5 (Strongly Agree); 3 (No Opinion).

Pre-and post-test scores were summed to determine students' overall perception shift of life skill development. A Cronbach's reliability analysis was performed and showed a pre-test reliability coefficient of 0.38 and post-test reliability coefficient of 0.63, an unacceptable reliability and a questionable reliability (George & Mallery, 2003). A variety of reasons may explain these low reliabilities. Caution is warranted in generalizing the findings beyond the sample group. A paired samples *t*-test showed no significant differences between the pre-test (M = 44.55, SD = 8.15) and post-test summed scores (M = 45.24, SD = 6.81). Overall, students agreed (M = 3.51 to 4.50) with all six of the positively phrased statements in both the pre-and post-tests. Students disagreed (M = 1.5 to 2.50) or had no opinion with six negatively phrased statements.

Teacher Perception of Students' Life Skill Development

Teacher respondents (N = 11) included all teachers who were present during the six weeks of selected JMG lessons led by the researcher in Quetzaltenango, Guatemala. Four of the participants were male and seven of the participants were female. Five teachers from Zunil and six teachers from Olintepeque completed the survey.

Participants were given the *Evaluation of Student Life Skill Development* post-participation in selected JMG lessons. This data were then used to answer research objective 5 and measure teachers' perceptions of students' life skill development as a result of participation in select JMG lessons. Table 3.2 shows means and standard deviations for teachers' responses to each of the 12 statements.

Table 3.2

Teachers' Evaluation of Student Life Skills Development (N = 11)

I believe that Junior Master Gardener (JGM) lessons…	M^{a}	*SD*
1. Helped to improve my students' ability to work well within groups	4.64	.51
2. Did **not** help my students to better understand themselves	1.82	.87
3. Helped improve my students' communication skills	4.45	.52
4. Did **not** help my students in developing decision making skills	1.55	.52
5. Helped my students to develop leadership skills	4.36	.51
6. Did **not** help my students learn about the value of helping others within their community.	1.73	.47
7. Helped them understand that other people's opinions are **not** important[b]	2.82	1.33
8. Helped my students gain better self-esteem	4.60	.52
9. Did **not** help improve my students' listening skills	1.91	.83
10. Helped my students think about the consequences of their decisions[b]	4.09	.83
11. Did **not** help my students to become better leaders	1.82	.87
12. Encouraged my students to do more for their communities	4.36	.51

Note. [a] Five-point Likert-type scale: 1 (Strongly Disagree) to 5 (Strongly Agree); 3 (No Opinion). [b] Indicates statements that were removed after reliability analysis.

Analysis of reliability showed a Cronbach's alpha coefficient of 0.60, indicating a satisfactory reliability (George & Mallery, 2003). Further analysis revealed that if statements 7 and 10 were removed, that the reliability coefficient would increase to 0.81, indicating a high internal reliability for the scale. Tests of significance were not conducted for this data because of the small sample size ($N = 11$) (Fraenkel & Wallen, 2009). However, observations of the overall means for each question are useful in determining teachers' perceptions of the selected JMG lessons. Teachers disagreed (M = 1.5 to 2.50) with all five negatively phrased statements, agreed (M = 3.51 to 4.50) with three, and strongly agreed ($M > 4.51$) with two of the positively phrased statements.

Conclusions and Recommendations

Student Perceptions of Life Skill Development

No difference was found between the pre-and post-test scores of the *Survey of Students' Perceptions of Life Skill Development*, indicating students' perceptions of their life skills development did not change as a result of participation in selected JMG lessons. Students had positive views of their life skills before and after participation in selected JMG lessons. The researcher does not believe that the lack of an observed statistical difference in pre-and post-test life skill evaluation can be attributed only to the JMG program; it may also be attributed to the low internal reliability of the scale. Many reasons may explain these findings, such as low comprehension or loss of intended implication of questions as a result of translation and the participants' young age (Dimitrov & Rumrill, 2003; Fallon & Schwab-Stone, 1994; Jacobs, 1991).

The original YLSI survey was developed and used with children and youth in the United States. However, it is important to consider that child development models are not universal, they are socially and culturally unique, and expectations that researchers have for children in the U.S. may not be reasonable for children in rural Guatemala (Woodhead, 1998). Children in the U.S. may have learned about or at least been introduced to concepts such as life skills like communication, leadership, and decision making strategies. U.S. children are more likely to understand and respond appropriately to the *Survey of Students' Life Skill Development* whereas children in rural Guatemala might be confused about these concepts. For example, students in rural Guatemala may not understand what was meant by the term "communication" or "leadership" because these are not terms they commonly use in their culture. Therefore, children in rural Guatemala may be less likely to correctly interpret and respond appropriately to the survey statements, decreasing the reliability of the instrument.

Language translation errors, between the researcher's native English and participants' native Spanish, may have decreased scale reliability (Bowling, 2005). The statements written in English may not translate exactly into statements in Spanish (Berkanovic, 1980). The English version of the test may not be linguistically equivalent to the Spanish version, causing some statements to be unidiomatic, making it confusing for children to respond (Berkanovic, 1980).

To improve future JMG programs in Guatemala, the researcher also recommends that more concrete objectives be created for life skill learning. Life skills are a learned process, just like any other skill and so JMG lessons should be strategically designed to enhance a certain skill (WHO, 1999). Before the lesson begins there should be an explanation of the life skill that teachers desire their students to attain as a result of a certain activity. Teachers should then provide students with progressively more demanding situations designed to enable children to practice the specific life skill (WHO, 1999). More time should be allowed for students to reflect on what they are leaning and a better connection should be made between life skills and technical science skills they are learning from JMG lessons. This coupling will help to promote a more positive attitude and stronger psychosocial development in the youth participants (WHO, 1999).

Teacher Perceptions of Students' Life Skill Development

The reliability for the teacher survey *Evaluation of Student Life Skill Development* was higher than the students' survey. Reliability of adult surveys is predictably higher than that of children surveys because of higher levels of cognition (Fallon & Schwab-Stone, 1994). Although the survey evaluating student perceptions of life skills development had a low reliability, the teacher survey provides an alternate more reliable method for analyzing impacts of JMG on this skill set. Teachers and parents may also be able to better evaluate youth life skill development when youth participants are too young to evaluate them on their own (Ferrari et al., 2004). Research demonstrates that reliability of instruments evaluating children's' emotions, such as perceptions about science, are less reliable than those evaluating observable concrete behaviors and ideas (Fallon & Schwab-Stone, 1994).

Teachers agreed (M = 3.51 to 4.50) or strongly agreed (M > 4.51) with all the positively phrased statements and disagreed (M = 1.5 to 2.50) with all the negatively phrased statements about their students' life skill development. Overall, teachers reported positive perceptions of JMG's impact on students' life skill development. Caution is warranted in generalizing these findings beyond the study because of the small sample size.

Future studies should make changes to the instrument and methods to improve reliability and scope of this research. Future studies should have the instrument evaluated by a group of children physiologists, anthropologists, and Spanish language experts to ensure that questions are phrased and translated accurately and that they are culturally appropriate. A qualitative study or mixed methods study should also be considered because children may be better able to express their thoughts and opinions through interviews rather than structured sentences on paper (Clark, 2011; Darbyshire, MacDougall, & Schiller, 2005).

Future studies should also consider conducting JMG lessons for longer periods, such as twelve weeks as opposed to six, because development of life skills may require extended time, interaction, and reflection with the material. The development of life skills is a “dynamic and evolving process” (pg. 6) so according the WHO, the ideal period of time needed for students to develop measurable changes in life skill development is at least 3-6 months (1999). Previous studies that have shown a positive correlation between participation in agricultural education activities, such as 4-H and FFA, and life skills development were conducted with youth who had been involved in these programs for more than six months at least (Maass et al., 2006; Robinson & Zajicek, 2005).

Other studies with similar results surveyed participants many years after their involvement in agricultural education activities. This may have allowed them more time to reflect on the impact that these activities had on their life skill development, making it easier to measure in the future (Fox et al., 2003). Therefore, it is possible that participation in JMG activities may lead to recognition of life skill development if youth are allowed to participate for a longer period of time and/or respond to surveys a few weeks or years after completing activities. Future studies should investigate these considerations because life skills are essential to helping youth transition from school to work. Life skills help youth to increase their “employability” by helping them to both find and keep a job (UNESCO, 2012). Also, future studies should consider including students of varying age groups to determine the effect of age on the impacts of participation in selected JMG lessons.

If these previously discussed changes to the instrument and methods were improved, future studies may significantly contribute to this field of international youth development in agriculture. JMG programs, and possibly other agricultural education programs, could then either be accepted or rejected as viable tools for governments or NGOs in developing countries working toward a stronger, more educated, and more capable youth population.

CHAPTER IV

CONCLUSIONS AND IMPLICATIONS

Horticultural education programs such as 4-H's Junior Master Gardener program can have an important influence on youth development in developing countries. This study found that students who participated in six weeks of selected JMG lessons significantly increased their science knowledge level. Students participating in this research were able to answer more science questions correctly on the post-test than did on the pre-test. Further analysis showed that students who were in a class with an active, friendly, and engaging teacher were more likely to increase their science knowledge scores than were students in classes with teachers who were seemingly disengaged from the JMG lessons. These findings confirmed research indicating that teacher attitude, participation, and discipline have an impact on students' abilities to learn (Allen, Witt, & Wheeless, 2006).

Teachers also felt that JMG lessons were important in stimulating their students' science knowledge in a variety of agricultural related topics. Teachers saw the lessons on the food chain and plants parts as the most effective lessons used throughout the six weeks of the JMG program. The survey results also indicated teachers believed that JMG lessons and activities were educational tools they would like to use in the future. By increasing students' scientific knowledge and stimulating students' desire to want to learn more about science, these programs are uniquely situated to prepare rural youth in developing countries for successful livelihoods (SARD, 2007; WHO, 2003). Many rural youth in developing countries are limited in their opportunities to attain quality education and are not adequately prepared to return to their agrarian lifestyles after school (WHO, 2003). JMG programs that help students gain knowledge and appreciation for scientific concepts such as soil science, plant needs, the water cycle, and insects, may help youth learn more about topics that pertain to their futures. For these reasons, JMG curriculum should be considered as a potential tool for international development programs. Giving youth the ability to better understand the complexities of the natural world around them may help to improve a country's future because research indicates that a country's development level is closely tied to its focus on STEM education (STEM Education Coalition, 2012).

Analysis of student science attitude surveys showed no significant change in science attitude as a result of participation in selected JMG lessons; however, teachers believed that JMG lessons were exciting and important for enhancing science learning in the classroom. Analysis of student life skill surveys also indicated no significant change in life skills development as a result of participation in selected JMG lessons, while teachers believed that JMG lessons were important in helping their students develop key life skills. For both pre-and post-surveys, students had overall positive attitudes toward science and a positive perceptions of their personal life skills development.

Many of the conclusions for this research are based on the teachers' surveys regarding their perceptions of the JMG program and its impacts on their students. These surveys were found to have a high internal reliability and so considered a more dependable source of information than the students' surveys. Research demonstrates that reliability of instruments evaluating children's emotions or self-perceptions are less reliable than those evaluating observable concrete behaviors and ideas (Fallon & Schwab-Stone, 1994). Reliability of adult surveys tends to be much higher than that of children's because of higher levels of cognition and ability to interpret and respond appropriately to survey questions (Fallon & Schwab-Stone, 1994).

Although this study detected no significant change in students' attitudes toward science or perceptions of life skills development, previous research evaluating youth's own perceptions of the impacts of 4-H programs in the U.S. supports the idea that 4-H can have significant impacts on these areas (Boleman & Cummings, 2002; Ferrari et al., 2004; Klemmer et al., 2005b). The researcher believes that the fact that this study did not support previous research was a result of low internal reliabilities in the science attitude scale and the life skills development scale. These low internal reliabilities could be attributed to several factors such as low comprehension of pre-test questions, loss of question implication because of differences in culture and language, and/or participants' age (Dimitrov & Rumrill, 2003; Fallon & Schwab-Stone, 1994; Jacobs, 1991). If changes were made to the survey and testing environment and the research was repeated, the researcher believes that results would most likely align more with conclusions from previous studies in agricultural education.

Future research studies should also consider evaluating the JMG program in rural Guatemala over a longer period of time. JMG lessons should be taught for a minimum of 6 months and surveys should be distributed to youth and teachers before, during, and after participation in the program. By allowing youth and teachers more time to interact with the JMG curriculum, impacts of the program may be easier to measure. Attitude changes and development of life skills may take a longer period of time to change than knowledge levels do because they involve complex emotions and psychological processes (WHO, 1999). More effort should also be placed on making sure that students understand what the terms "science" and "life skills" mean because these terms may have different meanings depending on the cultural context.

Before repeating this study over a longer period of time, the researcher also recommends that native Guatemalan teachers review the JMG curriculum to determine which lessons are most culturally/geographically appropriate and feasible in a developing country setting. While conducting this study, the researcher noticed that some of the JMG lessons did not seem applicable to a rural Guatemalan context because they referred to plants/animals that were uncommon in Guatemala or required materials that were expensive or hard to find. To improve this curriculum so that it can be easily applied in developing countries in the future, more time should be invested in selecting and modifying JMG lessons.

Overall, there is a lot of potential for future research and curriculum development with the JMG program. If the previously discussed steps are taken to improve evaluation and applicability of the JMG program, there is potential for JMG to become a valuable tool for international development projects as they strive to improve education and empower youth to make positive changes. By helping students develop a favorable attitude toward science and life skills such as group work, communication, leadership, and a desire to engage in community service, JMG programs equip youth to become active and effect forces of change within their communities and countries.

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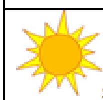
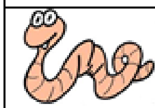
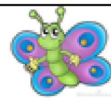
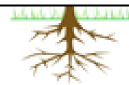
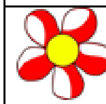
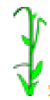
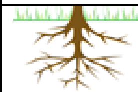
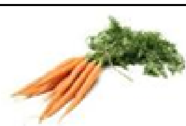
APPENDIX A

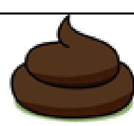
I am a girl ______ boy _________ Name ________________________

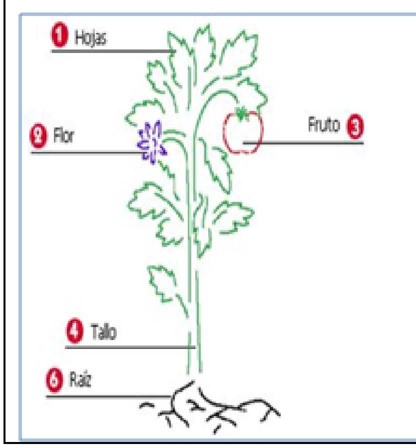
Assessment of Students' Scientific Knowledge Gain

1. Which of these is not necessary for a plant to survive?		
 sun	 soil	 water
 worms	 butterfly	 roots

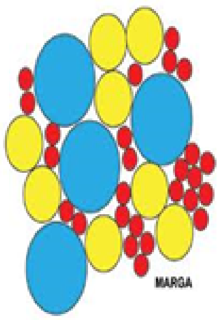
2. Which of these is not a part of a plant? Choose and circle only one answer.		
 flower	 Leaf	 Stem
 fruit	 roots	 worms

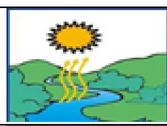
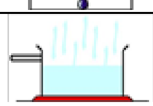
Circle the correct answer.	
	3. This image is an example of a: a. Seed b. Fruit c. Flower
	4. This image is an example of a: a. Leaf b. Stem c. Flower
	5. This image is an example of a: a. Roots b. Stem c. Flower

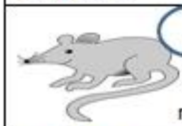
8. Which image is not a part of soil?		
 Worms	 rocks	 Dead leaves
 water	 manure	 trash

Put a: 6. circle around the part of the plant that is responsible for making food for the plant. 7. triangle around the part that gives strength and power to the plant against wind and rain.


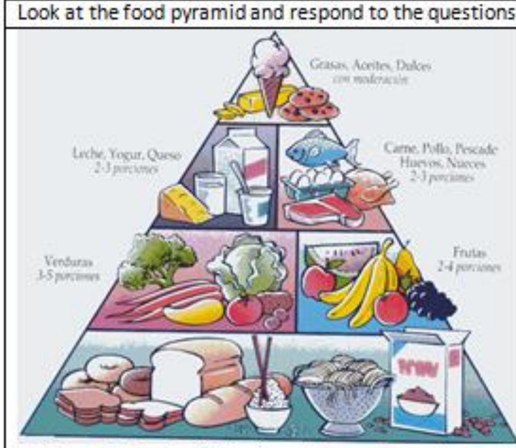
I am a girl ______ boy _________ Name ________________________

Soil is comprised of three different types of particles of different sizes: sand, silt, and clay. This image below represents the three types of particles.	
	9) The blue particles are the biggest and so represent: • sand • silt • clay 10) The red particles are the smallest and so represent: • sand • silt • clay

Put a circle around the correct response.	
	11. This image is an example of: a. Evaporation b. Precipitation c. Transpiration
	12. This image is an example of: a. Evaporation b. Transpiration c. Condensation
	13. This image is an example of: a. Evaporation b. Precipitation c. Condensation
	14. This image is an example of: a. Evaporation b. Precipitation c. Condensation
	15. What part of the surface of the world is covered in water? • 1/3 • ½ • 2/3 • 3/4

16. The images below represent animals in a food chain. Number the images en the correct order. Number 1 should represent the inferior part of the food chain and number 6 should represent the superior part of the food chain. Write the numbers inside the circles	
 Dead leaves	 halcon
 rat	 beatle
 snake	 worm

Look at the food pyramid and respond to the questions below.



Decide whether the following statements are true or false. Circle your response

17. It is healthy to eat more cookies than apples
    - True
    - False
18. It is healthy to eat more bread and tortillas than meat
    - True
    - False
19. I should eat fruits and vegetables every day.
    - True
    - False

I am a girl ______ boy _________ Name _______________________

Match each word with the correct image. Write one letter per line.

20. Mimicry ____________
21. Camouflage ___________
22. Reverse Camouflage ___________

a

b.

c.

Circle the correct response.		
23.) All of the images below represent the benefits of insects except one. Circle the example that is not a benefit of insects.	24.) Which of the items below is a benefit of insects. Circle your response. Choose only one answer.	25.) Insects use ________ to communicate. Circle your answer. Choose only one answer.
• Spread of diseases • Control of predators • Polination • Food for animals	• Stings • Bites • Descomposition • Destruction of plants	• Nose • mouth • hands • books

I am a girl ______ boy _________ Name ________________________

Survey of Students' Attitude toward Science

Respond to the phrases below. For each phrase, mark the box that corresponds to your answer. Read the phrases CAREFULLY.	No, I strongly disagree	I disagree	No opinion	I agree	Yes, I strongly agree
I would not like study more science in the future					
I would like to get work in the future where I can use science					
I think that I could be a good scientist one day					
I am excited to go to science classes					
science classes are not interesting					
we do not learn interesting things in science classes					
I do well in science classes					
my friends think that science classes are boring					
I learn things quickly in science classes					

Survey of Students' Perceptions of Life Skill Development

Respond to the phrases below. For each phrase, mark the box that corresponds to your answer. Read the phrases CAREFULLY.	No, I strongly disagree	I disagree	No opinion	I agree	Yes, I strongly agree
I do not work well with others					
I am proud of myself when i accomplish something					
It is important to listen to what other people have to say					
I do not think that it is important that all group members help to do work					
Before deciding anything, I think that it is important to think about all of my options					
I feel comfortable teaching other people new things					
I think that if I do something wrong, it is ok to blame someone else					
I like to do things to help improve the lives of others					
I do not follow instructions well					
When making a decision it is not important to think about good and bad things that could happen					
I think that it is important to help other people					
I do not like to be the leader of a group					

APPENDIX B

Teacher Evaluation of JMG programs

Gender: Female ☐ Male ☐

Grade of Students _____________

Number of Years Teaching ______________

<u>Development of Scientific Knowledge</u> I believe that Junior Master Gardener (JMG) lessons …	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
were important in enhancing my students' current studies					
were not important in enhancing my students' science learning abilities					
were not applicable or relevant for students in developing countries					
were important in stimulating my students' desire to learn more about science					
contained important information and activities for students in developing countries					
are an educational tool I would like to incorporate in the future					
are an educational tool I feel comfortable using					
were not effective in teaching my students about plant needs					
were effective in teaching my students about plant parts					
were not effective in teaching my students about different soil types					
were effective in teaching my students about soil composition					
were effective in teaching my students about the water cycle					
were not effective in teaching my students about soil erosion					
were effective in teaching my students about the food chain					
were not effective in teaching my students about the food web					
were not effective in teaching my students about insect survival mechanisms					
were effective in teaching my students about the benefits of insects					
were effective in teaching my students about nutritional needs					

Life Skill Development I believe that Junior Master Gardener (JGM) lessons…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
helped to improve my students' ability to work well within groups					
did not help my students to better understand themselves					
helped improve my students' communication skills					
did not help my students in developing decision making skills					
helped my students to develop leadership skills					
did not help my students learn about the value of helping others within their community					
helped them understand that other people's opinions are not important					
helped my students gain better self-esteem					
did not help improve my students' listening skills					
helped my students think about the consequences of their decisions					
did not help my students to become better leaders					
encouraged my students to do more for their communities					

APPENDIX C

List of JMG Lessons Taught in Guatemala (Retrieved from: *Junior Master Gardener teacher/leader guide: Level one*)	**Page**
Benefits Mobile	3
Plant Parts We Eat	10
Plant Needs (P.L.A.N.T.S.)	12
Earth Apple	38
The Water Cycle and You	37
Touchy Feely	25
Shake, Rattle, and Roll	26
The Food Chain Gang	47
Benefits of Insects	108
The Great Cover-Up	79
The Secret Smells Game	83
Nutrition in the Garden	183
Seeds Cards Activity	66